CERTIFICATE

I, the undersigned, Tetsuo AKIYOSHI, residing at 5th Floor, Shintoshicenter Bldg., 24-1, Tsurumaki 1-chome, Tama-shi, Tokyo 206-0034 Japan, hereby certify that to the best of my knowledge and belief the following is a true translation into English made by me of Japanese Patent Application No. 2000-149109 filed on May 19, 2000.

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[TITLE OF THE INVENTION] COMMUNICATION TERMINAL APPARATUS AND DEMODULATION METHOD

[SCOPE OF CLAIMS FOR PATENT]

[Claim 1] A communication terminal apparatus comprising:

determination point arranging means for arranging determination points based on power ratio information which is a ratio of transmission power of a common known signal to transmission power of a signal included in a channel having no known signal; and

demodulating means for performing quadrature amplitude demodulation of received data based to the determination points arranged by said determination point arranging means.

[Claim 2] The communication terminal apparatus according to claim 1, further comprising extracting means for extracting the power ratio information included in signals transmitted from a base station apparatus, wherein said determination point arranging means arranges the determination points based on the power ratio information extracted by said extracting means.

[Claim 3] A communication terminal apparatus comprising:

determination point arranging means for arranging determination points based on an average power ratio which is a ratio of reception power of a common known signal

transmitted from a base station apparatus to an average value for each processing timing of reception power of signals included in a channel having no known signal; and

demodulating means for performing quadrature amplitude demodulation of received data based on determination points arranged by said determination point arranging means.

[Claim 4] A base station apparatus comprising:

modulating means for switching a modulation method according to an estimated channel condition to modulate transmit data;

power ratio information calculating means for calculating power ratio information which is a ratio of transmission power of a common known signal to transmission power of a signal included in a channel having no known signal; and

transmitting means for transmitting calculated power ratio information to the communication terminal apparatus described in claim 2.

[Claim 5] A demodulation method comprising the steps of:

arranging determination points based on power ratio information which is a ratio of transmission power of a common known signal to transmission power of a signal included in a channel having no known signal; and

performing quadrature amplitude demodulation of

received data based on arranged determination points.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field of the Invention]

The present invention relates to a communication terminal apparatus that performs multi-valued quadrature amplitude modulation and a demodulation method that performs demodulation of a radio signal to which multi-valued quadrature amplitude modulation has been subjected.

[0002]

[Prior Art]

Recently, amplitude modulation that provides information in amplitude, such as multi-valued quadrature amplitude modulation (multi-valued QAM: Quadrature Amplitude Modulation), has been implemented as a digital radio communication modulation method that responds to growing communication needs. Multi-valued QAM enables numerous bits to be transmitted in one symbol, and gives improved spectral efficiency per band, making it a suitable modulation method for terrestrial mobile communications in which the spectrum is limited. For example, with 16QAM, 4 bits of information can be transmitted per symbol. Hereinafter, descriptions will use 16QAM as a representative example of amplitude modulation.

[0003]

FIG. 7 is a configuration diagram of a conventional radio transmission apparatus that performs radio transmission of QAM modulated data. As shown in this diagram, QAM modulated transmit data and control signals are transmitted by a base station apparatus 11 via an antenna 12. Transmit data from the base station apparatus 11 is received by a mobile station apparatus 14 via an antenna 13, after which it undergoes predetermined QAM demodulation.

[0004]

FIG. 8 is a drawing explaining channel assignment of a signal transmitted from the base station apparatus 11. Transmit data and control signals are transmitted using a Common PIlot CHannel (CPICH), Dedicated Physical CHannel (DPCH), and Downlink Shared CHannel (DSCH) shown in this drawing, and the like.

[0005]

A CPICH is a channel for transmitting a common known signal (common PL) to mobile stations. A DPCH is a channel for transmitting data, a dedicated known signal (dedicated pilot) for each mobile station apparatus, and a TFCI (Transmit Format Combination Indicator). A TFCI is a signal for reporting the DSCH transmission format (transmission rate, etc.) to the receiving side. A DSCH is a channel for transmitting QAM modulated data to mobile station apparatuses by time division, and the mobile station apparatus as a transmission partner can be changed

every frame.

[0006]

QAM demodulation in the mobile station apparatus 14 will next be described in detail with reference to FIG. 9. FIG. 9 is a 16QAM signal space representation. As determination of 16 values is performed in 16QAM, 16 determination points P1 to P16 are arranged in the I-Q plane as shown in this diagram. For these determination points, phase is determined based on a common pilot transmitted from the base station apparatus, and amplitude is determined based on a dedicated pilot.

[0007]

In the signal space representation, straight lines for which the distances from a determination point and the determination point nearest that determination point are exactly equal are set as threshold values. For example, a straight line for which the distances from P1 (3a, 3a) and its nearest point P2 (a, 3a) are exactly equal is straight line L parallel to the Q axis and passing through the midpoint (2a, 3a) of P1 and P2. In this case, straight line L is set as a threshold value. Threshold values are set in the same way for the other points, so that the threshold values shown in FIG. 9 are set.

[0008]

In QAM demodulation, receive data received by a mobile station is arranged on this signal space representation, the nearest determination point to the

receive data is found by making a threshold decision with threshold values set as described above, and information corresponding to the determination point found in this way is taken as demodulated data. As there are 16 determination point values, demodulated data is 4-bit data. That is to say, 4-bit data (0, 0, 0, 0), (0, 0, 0, 1) through (1, 1, 1, 1) are assigned to P1 through P16.

[0009]

[Problems to be Solved by the Invention]

As stated above, determination points are arranged based on the amount of phase rotation of a common PL and amplitude fluctuations of a dedicated PL. However, in order to suppress interference with other stations, a DPCH containing a dedicated PL is transmitted at weaker power than a CPICH containing a common PL, and there is consequently a problem in that a dedicated PL is susceptible to noise, and determination points in the signal space representation include a large degree of error in the amplitude direction, making it impossible to perform QAM demodulation with high precision.

Also, as a DSCH does not include a known signal for estimating a propagation path, there is a problem in that threshold values cannot be determined by a DSCH, which is transmitted at higher power than a DPCH.

[0010]

For this reason, it is an object of the present

invention to provide a mobile station apparatus and a demodulation method that enable determination points to be arranged accurately and QAM demodulation to be performed with high precision.

[0011]

[Means for Solving the Problems]

The A communication terminal apparatus of the present invention adopts the configuration comprising determination point arranging means for arranging determination points based on power ratio information which is a ratio of transmission power of a common known signal to transmission power of a signal included in a channel having no known signal and demodulating means for performing quadrature amplitude demodulation of received data based to the determination points arranged by the determination point arranging means.

[0012]

According to this configuration, by use of the common known signal, estimation of a propagation path and compensation for the propagation path are provided to the channel having no known signal necessary for determining the propagation path estimation and determination points, thereafter the determination points can be arranged using power ratio between power of the reported common known signal and the signal included in the channel having no known signal.

[0013]

The communication terminal apparatus of the present invention adopts, in the above communication terminal apparatus, the configuration further comprising extracting means for extracting the power ratio information included in signals transmitted from a base station apparatus, wherein the determination point arranging means arranges the determination points based on the power ratio information extracted by the extracting means.

[0014]

According to this configuration, by use of the common known signal, estimation of a propagation path and compensation for the propagation path are provided to the channel having no known signal necessary for determining the propagation path estimation and determination points, thereafter the determination points can be arranged using power ratio between power of the common known signal estimated by the terminal apparatus and the signal included in the channel having no known signal.

[0015]

The communication terminal apparatus of the present invention adopts the configuration comprising determination point arranging means for arranging determination points based on an average power ratio which is a ratio of reception power of a common known signal transmitted from a base station apparatus to an average

value for each processing timing of reception power of signals included in a channel having no known signal, and demodulating means for performing quadrature amplitude demodulation of received data based on determination points arranged by the determination point arranging means.

[0016]

According to this configuration, even when transmission power ratio information between the common control signal from the base station and the channel having no known signal is not reported, reception power of the common control signal and that of the signal included in the downlink shared channel are measured at the mobile station apparatus, thereafter the power ratio is estimated, and this makes it possible to perform demodulation accurately even if amplitude modulation is used in the channel having no known signal.

[0017]

The base station apparatus of the present invention adopts the configuration comprising modulating means for switching a modulation method according to an estimated channel condition to modulate transmit data, power ratio information calculating means for calculating power ratio information which is a ratio of transmission power of a common known signal to transmission power of a signal included in a channel having no known signal, and transmitting means for transmitting calculated power

ratio information to the aforementioned communication terminal apparatus.

[0018]

According to this configuration, since calculated power ratio information is transmitted to the communication terminal apparatus that performs QAM demodulation, the communication terminal apparatus can arrange the determination points accurately based on the received power ratio information, so that QAM demodulation can be performed with high precision.

[0019]

The demodulation method of the present invention is that determination points are arranged based on power ratio information which is a ratio of transmission power of a common known signal to transmission power of a signal included in a channel having no known signal, and quadrature amplitude demodulation of received data is performed based on arranged determination points.

[0020]

According to this method, since the determination points are arranged based on the common known signal and power ratio information, the determination points can be arranged with no influence of noise and the like. Then, since determination of reception data is performed based on the accurate determination points thus arranged, it is possible to perform QAM demodulation with high precision.

[0021]

[Embodiments of the Invention]

The outline of the present invention is that the arrangement of determination points is decided based on power ratio information indicating the ratio of the transmission power of a predetermined common PL to the transmission power of a predetermined signal contained in a channel that does not have a known signal to be QAM modulated, whereby reducing error in determination points arrangement, and performing QAM demodulation with high precision.

[0022]

It is desirable to use a DSCH, which is transmitted as being paired with a DPCH, as the channel that does not have a known signal.

[0023]

The following will specifically explain the embodiments of the present invention with reference to the drawings accompanying herewith.

(Embodiment 1)

In this embodiment, a base station apparatus reports information indicating the ratio of the transmission power of a predetermined common PL to the transmission power of a DSCH predetermined signal to be QAM modulated (power ratio information) to a mobile station apparatus, and the mobile station apparatus arranges determination points accurately based on this power ratio information

and performs QAM demodulation with high precision.

[0024]

FIG. 1 is a block diagram showing the configuration of a radio transmission apparatus according to Embodiment 1 of the present invention. As shown in this diagram, a radio transmission apparatus according to this embodiment comprises a base station apparatus 100 and mobile station apparatuses 110-1 through 110-K. The base station apparatus 100 transmits data and control signals to mobile station apparatuses 110-1 through 110-K. Mobile station apparatuses 110-1 through 110-K receive a signal from the base station apparatus 100 and demodulate it using a predetermined method.

[0025]

FIG. 2 is a view explaining channel assignment of a signal transmitted from the base station apparatus 100. Transmit data and control signals are transmitted using the Common PIlot CHannel (CPICH), Dedicated Physical CHannel (DPCH), and Downlink Shared CHannel (DSCH) shown in this drawing, and the like.

[0026]

The CPICH is a channel for transmitting a common known signal (common PL) to mobile station apparatuses 110-1 through 110-K. This common PL is received by each of mobile station apparatuses 110-1 through 110-K and used for channel estimation, etc.

[0027]

The DPCH is a channel for transmitting data, a dedicated known signal (dedicated PL) for each mobile station apparatus, and a TFCI (Transmit Format Combination Indicator). A dedicated PL is received by the corresponding mobile station apparatus 110-1 through 110-K and used for channel estimation, etc. The TFCI is a signal for reporting the DSCH transmission format to the receiving side, and in this embodiment, a signal indicating the modulation method and power ratio information, in particular, are set in this TFCI. In addition, power ratio information is information indicating the ratio of the transmission power of a predetermined common PL to the transmission power of a DSCH to be QAM modulated, and is received by a corresponding mobile station apparatus 110-1 through 110-K and used to arrange determination points.

[0028]

Furthermore, the DSCH is a channel for transmitting QAM modulated data to a designated mobile station apparatus, and a channel that has no known signal. With this DSCH, the mobile station apparatus as a transmission partner can be changed every frame.

[0029]

The configuration of a radio transmission apparatus according to Embodiment 1 of the present invention will be described with reference to FIG. 1 again. The base station apparatus 100 comprises a controller 101, a data

buffer 102, a DSCH modulation/spreading section 103, DPCH modulation/spreading sections 104-1 through 104-K, a CPICH modulation/spreading section 105, a multiplexer 106, a radio transmitting section 107, and an antenna 108. Furthermore, mobile station apparatus 110-K comprises an antenna 111, a radio receiving section 112, a CPICH despreading section 113, a DPCH despreading section 114, a DSCH despreading section 115, channel estimation sections 116 and 117, a DPCH demodulation section 118, a power ratio extraction section 119, a modulation method determination section 120, and a DSCH demodulation section 121.

[0030]

In the base station apparatus 100, the controller 101 selects mobile station apparatus 110-K as the mobile station apparatus that performs transmission the DSCH. In addition, the modulation method of the DSCH modulation/spreading section 103 is decided by referring to the channel condition estimation result. For example, when channel conditions are good, 64QAM, 16QAM, or similar modulation is performed in order to increase the transmission rate. Conversely, when channel conditions are poor, QPSK, BPSK, or similar modulation is performed in order to decrease the transmission rate. A signal indicating the decided transmission rate is output to the data buffer 102, DSCH modulation/spreading section 103, and DPCH modulation/spreading section 104-K. The

data buffer 102 temporarily holds data d1 to be transmitted to mobile station apparatus 110-K, and outputs the held data d1 to the DSCH modulation/spreading section 103 in accordance with control by the controller 101. The DSCH modulation/spreading section 103 provides QAM modulation or phase modulation on data d1 output from the data buffer 102 in accordance with control by the controller 101, spreads the modulated signal using spreading code #K specific to mobile station apparatus 110-K as a transmission partner, and outputs the resulting signal to the multiplexer 106.

[0031]

In addition, the controller 101 calculates power ratio information and outputs it to DPCH modulation/spreading section 104-K. DPCH modulation/spreading section 104-K sets the signal indicating the modulation method and power ratio information from the controller 101 in the TFCI, and composes a frame with this TFCI, a dedicated pilot, and data. Power ratio information is information indicating the ratio of the transmission power of a predetermined common PL to the transmission power of a DSCH predetermined signal to be QAM modulated. The framed signal is modulated using a predetermined modulation method, and is then spread using spreading code #K specific to mobile station apparatus 110-K, and the spread signal is output to the multiplexer 106.

[0032]

DPCH modulation/spreading sections 104-1 through 104-K are provided to correspond to mobile station apparatuses 110-1 through 110-K. Each of DPCH modulation/spreading sections 104-1 through 104-(K-1) composes a frame with a dedicated PL, TFCI, and data to be transmitted to corresponding mobile station apparatus 110-1 through 110-(K-1), and modulates the framed signal using a predetermined modulation method. Then, the modulated signal is multiplied by the spreading code specific to the corresponding mobile station, and output to the multiplexer 106.

[0033]

The CPICH modulation/spreading section 105 modulates a common PL to be transmitted on the CPICH using a predetermined modulation method, multiplies the modulated common PL by a spreading code common to all mobile station apparatuses 110-1 through 110-K, and outputs the resultant to the multiplexer 106.

[0034]

The multiplexer 106 multiplexes the spread signals output from the DSCH modulation/spreading section 103, DPCH modulation/spreading sections 104-1 through 104-K, and CPICH modulation/spreading section 105, and outputs the resultant to the radio transmitting section 107. The radio transmitting section 107 performs predetermined radio transmission processing (such as up-conversion)

on the multiplexed transmit signal from the multiplexer 106, and performs radio transmission to mobile station apparatuses 110-1 through 110-K via antenna 108.

[0035]

Next, the configuration of mobile station apparatus 110-K will be described.

In mobile station apparatus 110-K, the radio receiving section 112 performs predetermined radio reception processing (such as down-conversion) to a received signal received via the antenna 111. In addition, signals to which radio reception processing has been provided are separated on a channel-by-channel basis, and the resultant is output to the CPICH despreading section 113, DPCH despreading section 114, and DSCH despreading section 115. That is to say, a signal transmitted using the CPICH is output to the CPICH despreading section 113, a signal transmitted using the DPCH is output to the DPCH despreading section 114, and a signal transmitted using the DSCH is output to the DSCH despreading section 115.

[0036]

The CPICH despreading section 113 despreads the output (common PL) from the radio receiving section 112 by means of a predetermined spreading code, and outputs the despread signal to channel estimation section 116. The DPCH despreading section 114 despreads the output (dedicated PL, TFCI, and data) from the radio receiving

section 112 with spreading code #K, and outputs the despread signal to channel estimation section 117 and the DPCH demodulation section 118. The DSCH despreading section 115 despreads output (data d1) from the radio receiving section 112 with spreading code #K, and outputs the despread signal to the DSCH demodulation section 121.

[0037]

Channel estimation section 116 performs channel estimation using the despread common PL from the CPICH despreading section 113, and calculates channel estimates (amplitude fluctuation and phase rotation amount). The calculated channel estimates are then output to the DPCH demodulation section 118 and DSCH demodulation section 121. Channel estimation section 117 performs channel estimation using the despread dedicated PL from the DPCH despreading section 114, and calculates channel estimates (amplitude fluctuation and phase rotation amount). Of the calculated channel estimates, the amplitude fluctuation is then output to the DPCH demodulation section 118. The DPCH demodulation section 118 performs predetermined demodulation processing such as QPSK based on the channel estimates from channel estimation section 116 and the amplitude fluctuation from channel estimation section 117, and obtains demodulated data. This demodulated data is sent to the power ratio extraction section 119 and modulation method determination section 120. The power ratio extraction section 119 extracts

power ratio information from the TFCI of the demodulated data from the DPCH demodulation section 118, and outputs the extracted power ratio information to the DSCH demodulation section 121. The modulation method determination section 120 refers to the TFCI of the demodulated data output from the DPCH demodulation section 118 and determines the modulation method in the DSCH modulation/spreading section 103, and outputs a signal indicating the result of the determination to the DSCH demodulation section 121.

[0038]

Based on the channel estimates from channel estimation section 116, power ratio information from the power ratio extraction section 119, and the signal indicating the modulation method from the modulation method determination section 120, the DSCH demodulation section 121 switches the modulation method, performs predetermined demodulation processing on data d1 output from the DSCH, and obtains demodulated data.

[0039]

Next, the operation of mobile station apparatus 110-K with the above configuration will be described.

A multiplex signal framed as shown in FIG. 2 from the base station apparatus 100 is received as a radio signal via the antenna 111 of mobile station apparatus 110-K, and is then despread by each channel. A common PL transmitted using the CPICH is despread by the CPICH

despreading section 113 and then undergoes channel estimation in channel estimation section 116, and channel estimates are output to the DPCH demodulation section 118 and DSCH demodulation section 121. A dedicated PL transmitted via the DPCH is despread by the DPCH despreading section 114 and then undergoes channel estimation in channel estimation section 117, and amplitude fluctuation is output to the DPCH demodulation section 118. In the DPCH demodulation section 118, the data and TFCI transmitted using the DPCH are demodulated by means of a predetermined modulation method, and demodulated data is obtained. TFCI demodulated data is sent to the power ratio extraction section 119 and modulation method determination section 120. In the power ratio extraction section 119, power ratio information is extracted from the TFCI demodulated data and the extracted power ratio information is output to the DSCH demodulation section 121. In the modulation method determination section 120, the TFCI demodulated data is referenced and the modulation method in the DSCH modulation/spreading section 103 is determined, and a signal indicating the result of the determination is output to the DSCH demodulation section 121.

[0040]

Moreover, data d1 transmitted using the DSCH is despread by the DSCH despreading section 115, and is then output to the DSCH demodulation section 121. In the DSCH

demodulation section 121, data d1 despread by the DSCH demodulation section is demodulated based on the channel estimates from channel estimation section 116, power ratio information from the power ratio extraction section 119, and the signal indicating the modulation method from the modulation method determination section 120.

[0041]

Demodulation processing by the DSCH demodulation section 121 will be next described in detail with reference to FIG. 3. FIG. 3 is a block diagram showing the configuration of the DSCH demodulation section 121. As shown in this diagram, the DSCH demodulation section 121 comprises a modulation method switching section 301, phase demodulation section 302, and QAM demodulation section 303.

[0042]

In the modulation method switching section 301, switching between a phase modulation method and QAM modulation method is controlled based on a signal indicating the determination result from the modulation method determination section 120. When a switch is made to a phase modulation method, a signal to that effect is output to the phase demodulation section 302, and in the phase demodulation section 302 data d1 from the DSCH despreading section 115 undergoes phase demodulation such as QPSK or BPSK. On the other hand, when a switch is made to a QAM demodulation method, a signal to that effect

is output to the QAM demodulation section 303. In this case, data d1 from the DSCH despreading section 115 is QAM demodulated in the QAM demodulation section 303 in accordance with channel estimates from channel estimation section 116 and power ratio information from the power ratio extraction section 119, and demodulated data is obtained.

[0043]

Next, QAM demodulation in a mobile station apparatus according to this embodiment will be described with reference to FIG.4. As shown in this figure, 16 determination points P1 through P16 are arranged in the I-Q plane. The following will explain the arrangement of 16QAM determination points P1 through with reference to FIG.4. As an example, a case will be described in which information indicating the ratio of the transmission power of a common pilot indicating point P shown in FIG.4 to the transmission power of a DSCH signal indicating determination point P1 shown in FIG.4 is transmitted from the base station apparatus 100 as power ratio information.

[0044]

As determination points are arranged with P1, placed on the basis of a common PL and power ratio information, as a reference, the placement of P1 will first be explained.

[0045]

In order to place P1 shown in FIG.4, the phase and amplitude of P1 are determined. The phase of P1 is the

same as that of the common PL. The common PL is placed at point P in the I-Q plane after compensating for the channel estimated phase rotation amount, and the phase of P1 is determined with reference to the phase of point P. For the amplitude of P1, the point P amplitude (distance from the origin) is multiplied by power ratio information, and the result is taken as the amplitude of P1. P1 (3a, 3a) is then placed based on the phase and amplitude determined in this way.

[0046]

Next, P2 through P16 are determined based on P1. P2 has the same Q coordinate as P1, and the I coordinate is placed at a point (a, 3a) such that P1:P2 = 3:1. P3 has the same I coordinate as P1, and the Q coordinate is placed at a point (3a, a) such that P1:P3 = 3:1. Thereafter, 16 determination points shown in FIG.4 are arranged in the same way.

[0047]

Moreover, straight lines for which the distances from a determination point and the determination point nearest that determination point are exactly equal are set as threshold values. For example, a straight line for which the distances from P1 (3a, 3a) and its nearest point P2 (a, 3a) are exactly equal is straight line L parallel to the Q axis and passing through the midpoint (2a, 3a) of P1 and P2. In this case, straight line L is set as a threshold value. Threshold values are set for

the other points in the same way.

[0048]

Thus, in this embodiment, the amplitude of a determination point is calculated by multiplying the amplitude of a common PL with large power by power ratio information transmitted from the base station apparatus. Therefore, determination points can be arranged with effects of noise as being held low compared with the conventional case.

[0049]

In QAM demodulation, received data received by a mobile station is arranged in a signal space representation set as described above, and the nearest determination point to the received data is found by making a threshold decision with set threshold values. Then, information corresponding to the determination point found in this way is taken as demodulated data.

[0050]

Thus, in this embodiment, since determination points are arranged based on power ratio information and a common PL included in a signal transmitted from the base station apparatus, determination points can be arranged accurately with effects of noise, etc., as being held low. And as received data determination is carried out based on accurate determination points arranged in this way, QAM demodulation can be performed with high precision.

[0051]

FIG.5 is a signal space representation for a case of reception with a small common PL amplitude. As shown in this diagram, the amplitude of the common pilot varies and it is placed at P′. The amplitude of this point P′ is multiplied by power ratio information to determine the amplitude of P1′, and P1′ is placed based on the amplitude determined in this way. Other determination points are arranged as shown in FIG.5 with reference to P1′. In this way, when fading that affects a received signal according to changes in channel conditions varies, determination points can be arranged appropriately according to that fading. Therefore, determination points can be arranged accurately and QAM modulation performed with high precision even when channel conditions change.

[0052]

Additionally, in this embodiment, the amplitude of P1 is determined by multiplying power ratio information by the amplitude of point P at which a common PL is placed, but it is also possible to divide the amplitude of point P at which a common pilot is placed by power ratio information according to the method of calculating the power ratio information.

[0053]

Also, in this embodiment, only the case where the DSCH is used for transmission to mobile station apparatus

110-K has been described, but use for transmission to other mobile station apparatuses is also possible.

[0054]

Furthermore, in this embodiment, only the case has been described where power ratio information is taken as the ratio of the transmission power of a common known signal to the transmission power of a signal included in a channel that does not have a known signal, but the present invention is not limited to the above case, and the ratio of the transmission power of a common known signal to the transmission power of another known signal may also be used.

[0055]

Moreover, in this embodiment, only the case has been described where information indicating the ratio of the transmission power of a common pilot indicating point P shown in FIG.4 to the transmission power of a DSCH signal indicating determination point P1 shown in the same FIG.4 is transmitted from the base station apparatus 100 as power ratio information, but this is not a limitation, and, in calculating power ratio information, it is possible for a predetermined common PL to change as appropriate according to the modulation method, and it is possible for a predetermined DSCH to change appropriately according to the common PL.

[0056]

(Embodiment 2)

In this embodiment, the ratio of the average value of common pilot reception power to the average value of reception power of a predetermined signal included in a DSCH (average power ratio) is calculated on the mobile station apparatus side, whereby performing QAM modulation with high precision and determining the signal space representation based on this average power ratio.

[0057]

FIG. 6 is a block diagram showing the configuration of a radio transmission apparatus according to this embodiment. As shown in this diagram, in the configuration of a transmitting apparatus according to this embodiment, the power ratio extraction section 119 of the transmitting apparatus shown in FIG. 1 is omitted, the channel estimation section 117 is replaced by a channel estimation section 601, and the DSCH demodulation section 121 is replaced by a DSCH demodulation section 602. Parts in FIG. 6 identical to those in FIG. 1 are assigned the same codes as in FIG. 1 and their detailed explanations are omitted.

[0058]

The channel estimation section 601 performs channel estimation using a dedicated PL despread by the DPCH despreading section 114, and calculates channel estimates (amplitude fluctuation and phase rotation amount). Of the calculated channel estimates, the amplitude fluctuation is then output to the DPCH demodulation

section 118 and the DSCH demodulation section 602.

[0059]

Based on the channel estimates from channel estimation section 116, amplitude fluctuation from channel estimation section 601, and the signal indicating the modulation method from the modulation method determination section 120, the DSCH demodulation section 602 switches the modulation method, provides predetermined demodulation processing to data d1 output from the DSCH despreading section 115, and obtains demodulated data.

[0060]

The DSCH demodulation section 602 switches the demodulation method based on the signal indicating the modulation method from the modulation method determination section 120. When, as a result of this switch, QAM demodulation is performed, the average value for one slot of the reception power of a predetermined signal included in the QAM modulated DSCH is calculated based on the amplitude fluctuation from channel estimation section 601. Then the ratio of the calculated reception power average value to the common PL reception power calculated based on the channel estimates from channel estimation section 116 is calculated, and this is taken as the average power ratio. Determination points are arranged based on the average power ratio calculated in this way and the channel estimates from channel

estimation section 116, and QAM demodulation is carried out by making threshold decisions based on the arranged determination points. As regards calculation of the average value of dedicated PL reception power, an average value may be calculated for another time interval rather than every slot.

[0061]

Herein, the explanation will be given of the arrangement of determination points according to this embodiment with reference to FIG.7 again. In this embodiment, the amplitude of point P is not multiplied by power ratio information as in Embodiment 1, and the amplitude of P1 is determined by multiplying the amplitude of point P by the above-described average power ratio.

[0062]

In order to place P1 shown in FIG.4, the phase and amplitude of P1 are determined. The phase of P1 is the same as that of the common PL. The common PL is placed at point P in the I-Q plane after compensating for the channel estimated phase rotation amount, and the phase of P1 is determined with reference to the phase of point P. For the amplitude of P1, the point P amplitude (distance from the origin) is multiplied by the average power ratio, and the result is taken as the amplitude of P1. P1 (3a, 3a) is then placed based on the phase and amplitude determined in this way. P2 through P16 and threshold values are then arranged, and received data

determination performed, in the same way as in Embodiment 1.

[0063]

Thus, according to this embodiment, even if common PL and DSCH transmission power ratio information from the base station is not conveyed, the reception power of the common PL and the reception power of the DSCH are measured in the mobile station apparatus, and the power ratio is then estimated, with the result that demodulation can be performed correctly even when amplitude modulation is used for a DSCH that does not have a known signal.

[0064]

Additionally, in this embodiment, the amplitude of P1 is determined by multiplying the average power ratio by the amplitude of point P at which a common PL is placed, but it is also possible to divide the average power ratio by the amplitude of point P at which a common PL is placed or to divide the common PL amplitude by the average power ratio according to the method of calculating the power ratio information.

[0065]

Also, in the above-described embodiments, only the case where a base station apparatus communicates with a mobile station apparatus has been described, but the present invention is not limited to this, and communication may also be carried out with a communication terminal apparatus other than a mobile station.

[0066]

[Effects of the Invention]

As described above, according to the present invention, it is possible to perform demodulation of amplitude modulation using a common PL even when amplitude modulation is used on a DSCH that does not have a known signal.

[BRIEF DESCRIPTION OF DRAWINGS]

[FIG. 1]

A block diagram showing the configuration of a radio transmission apparatus according to Embodiment 1 of the present invention.

[FIG. 2]

A view explaining channel assignment of a signal transmitted from a base station apparatus according to Embodiment 1 of the present invention.

[FIG. 3]

A block diagram showing the configuration of a DSCH demodulation section according to Embodiment 1 of the present invention.

[FIG.4]

A view explaining the arrangement of 16QAM determination points.

[FIG.5]

A view explaining the arrangement of 16QAM determination points.

[FIG. 6]

A block diagram showing the configuration of a radio transmission apparatus according to Embodiment 2 of the present invention.

[FIG. 7]

A block diagram showing a configuration of a conventional radio transmission apparatus.

[FIG. 8]

A view explaining channel assignment of a signal transmitted from a conventional base station apparatus.

[FIG. 9]

A 16QAM signal space representation.

[Description of the Symbols]

100 Base station apparatus

101 Controller

103 DSCH modulation/spreading section

104-1 to 104-K DPCH modulation/spreading sections

105 CPICH modulation/spreading section

110-1 to 110-K Mobile station apparatus

113 CPICH despreading section

114 DPCH despreading section

115 DSCH despreading section

116, 117, 601 Channel estimation sections

118 DPCH demodulation section

119 Power ratio extraction section

120 Modulation method determination section

121, 602 DSCH demodulation sections

303 QAM demodulation section

[NAME OF DOCUMENT] ABSTRACT

[Abstract]

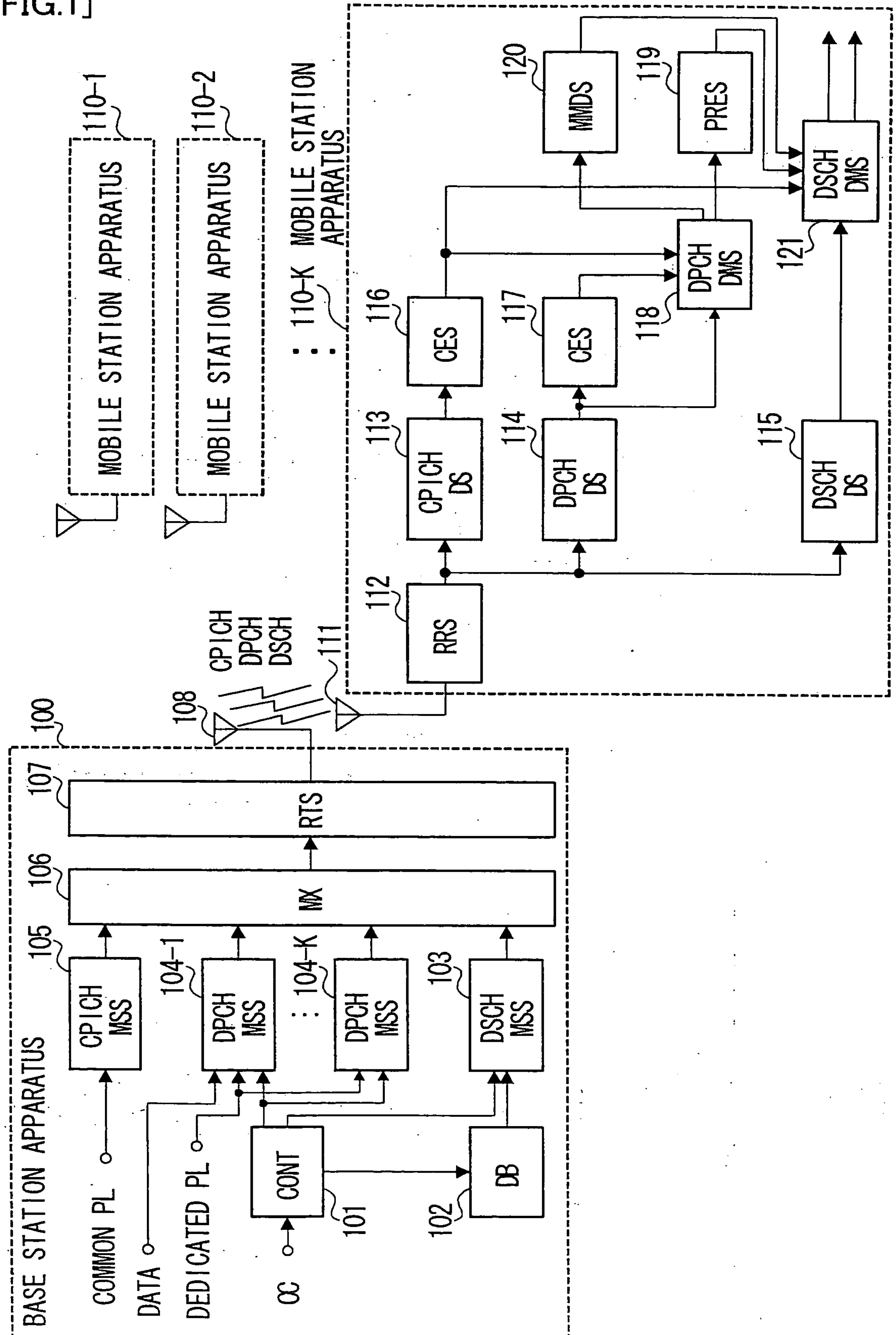
[Object] To place determination points accurately and perform QAM demodulation with high precision.

[Overcoming Means] A base station apparatus 100 conveys information indicating the ratio of the transmission power of a common known signal (common PL) included in a common control channel to the transmission power of a signal included in a downlink shared channel to a mobile station apparatus 110-K. Based on this power ratio information, the mobile station apparatus 110-K arranges determination points accurately and performs QAM demodulation with high precision.

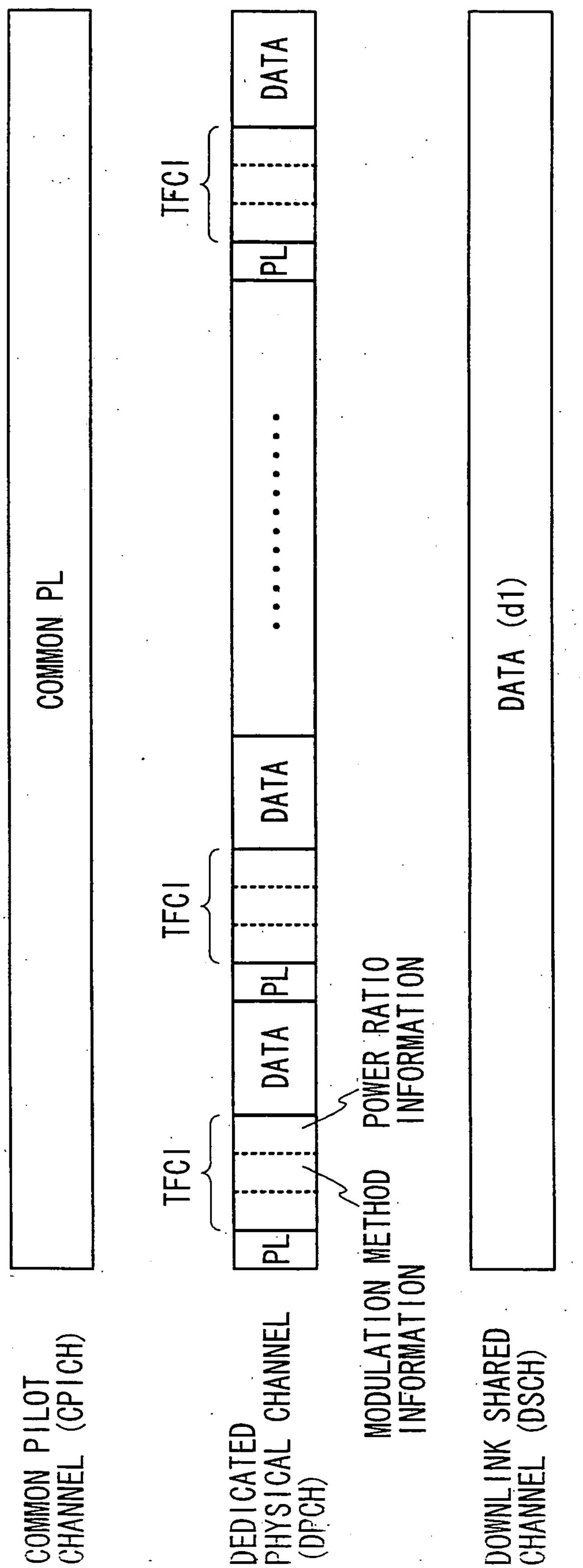
[Selected Drawing] FIG. 1

[NAME OF DOCUMENT] DRAWINGS

[FIG.1]

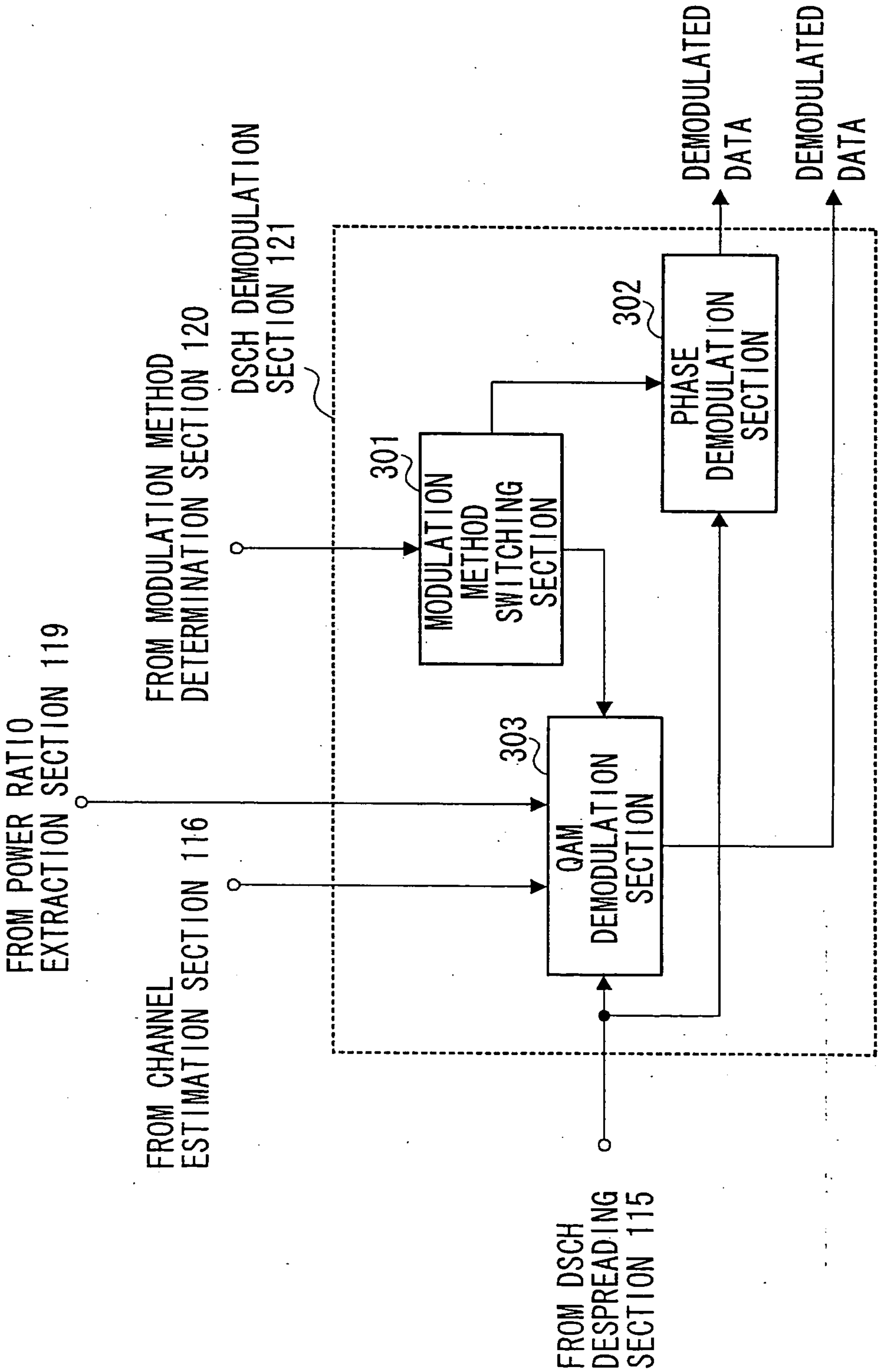


[FIG.2]



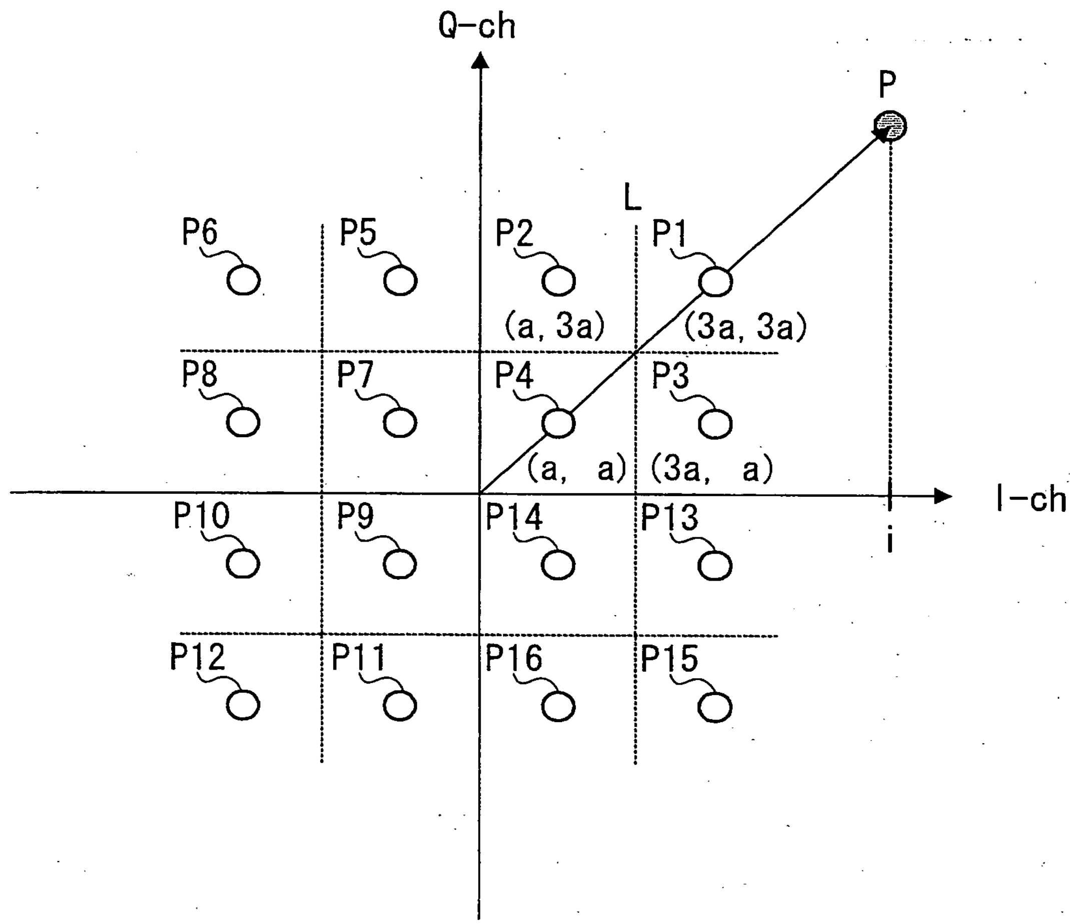
COMMON PILOT CHANNEL (CPICH)
COMMON PL
DEDICATED PHYSICAL CHANNEL (DPCH)
PL
TFCI
DATA
PL
TFCI
DATA
DATA
PL
TFCI
DATA
MODULATION METHOD INFORMATION
POWER RATIO INFORMATION
DOWNLINK SHARED CHANNEL (DSCH)
DATA (d1)

[FIG.3]

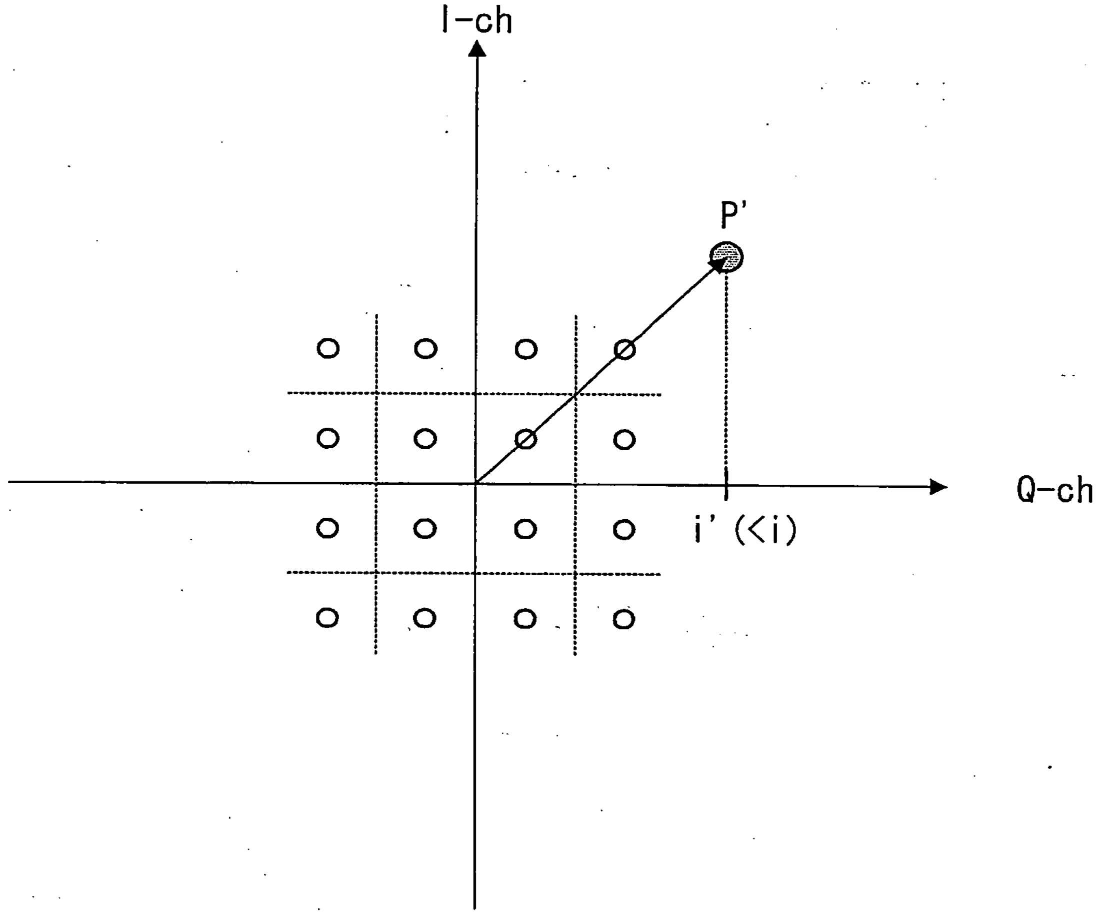


FROM DSCH DESPREADING SECTION 115
FROM CHANNEL ESTIMATION SECTION 116
FROM POWER RATIO EXTRACTION SECTION 119
FROM MODULATION METHOD DETERMINATION SECTION 120
DSCH DEMODULATION SECTION 121
301
MODULATION METHOD SWITCHING SECTION
302
PHASE DEMODULATION SECTION
303
QAM DEMODULATION SECTION
DEMODULATED DATA
DEMODULATED DATA

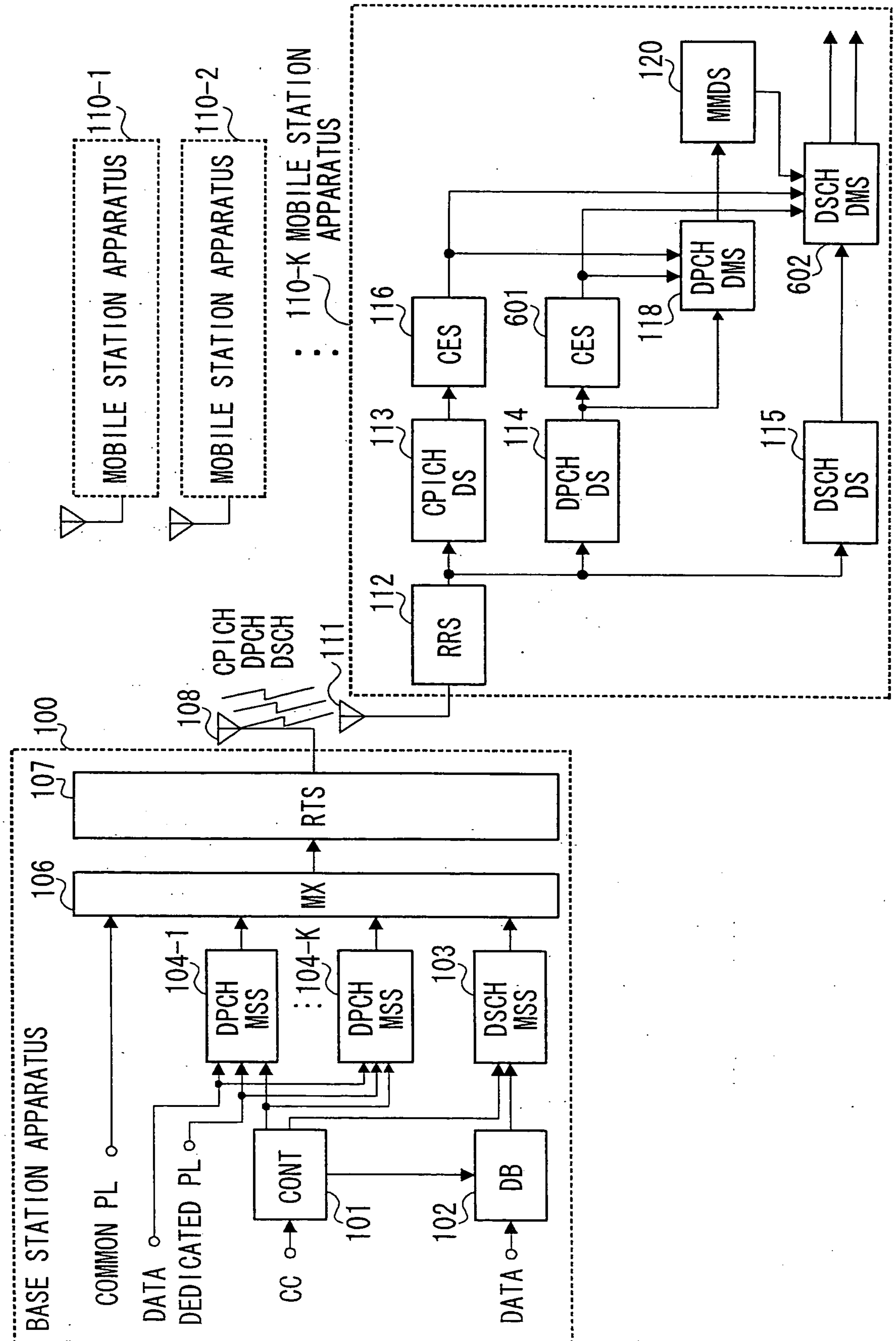
[FIG.4]


Q-ch
P
L
P6
P5
P2
P1
(a, 3a)
(3a, 3a)
P8
P7
P4
P3
(a, a)
(3a, a)
I-ch
P10
P9
P14
P13
i
P12
P11
P16
P15

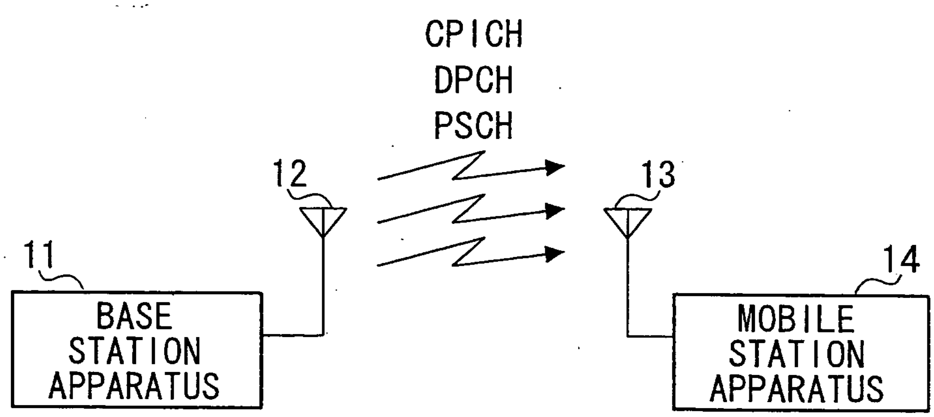
[FIG.5]



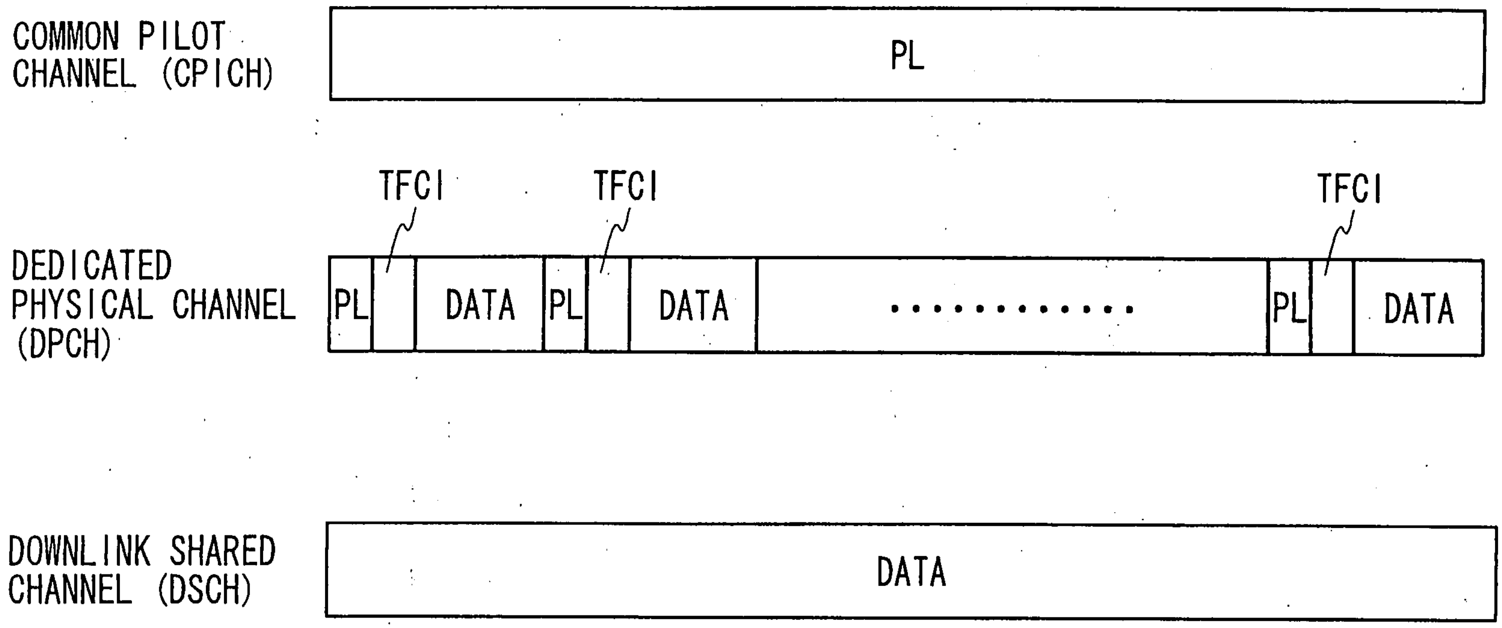
[FIG.6]


BASE STATION APPARATUS
100
COMMON PL
DATA
DEDICATED PL
CC
DATA
CONT
101
DB
102
DPCH MSS
104-1
DPCH MSS
104-K
DSCH MSS
103
MX
106
RTS
107
108
CPICH
DPCH
DSCH
111
MOBILE STATION APPARATUS
110-1
MOBILE STATION APPARATUS
110-2
110-K MOBILE STATION APPARATUS
RRS
112
CPICH DS
113
DPCH DS
114
DSCH DS
115
CES
116
CES
601
DPCH DMS
118
DSCH DMS
602
MMDS
120

[FIG.7]

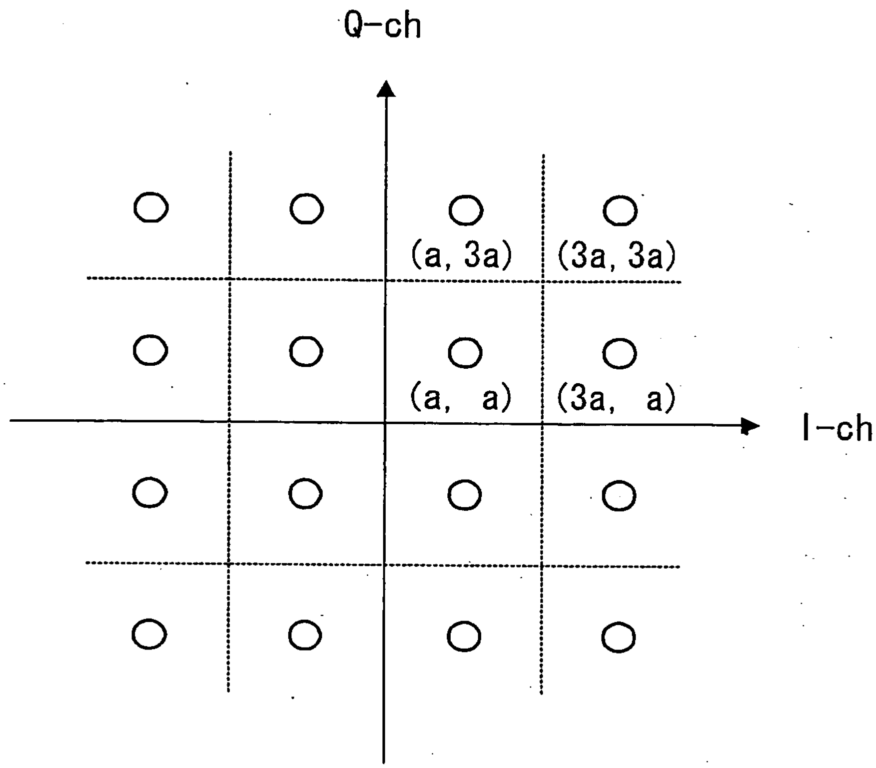

CPICH
DPCH
PSCH
12
13
11
BASE STATION APPARATUS
14
MOBILE STATION APPARATUS

[FIG.8]



COMMON PILOT CHANNEL (CPICH)
PL
DEDICATED PHYSICAL CHANNEL (DPCH)
TFCI
TFCI
TFCI
PL
DATA
PL
DATA
PL
DATA
DOWNLINK SHARED CHANNEL (DSCH)
DATA

[FIG.9]



[FIG. 1]

	CC : CHANNEL CONDITION
101	CONT : CONTROLLER
102	DB : DATA BUFFER
103	DSCHMSS : DSCH MODULATION/SPREADING SECTION
104-1	DPCHMSS : DPCH MODULATION/SPREADING SECTION
104-K	DPCHMSS : DPCH MODULATION/SPREADING SECTION
105	CPICHMSS : CPICH MODULATION/SPREADING SECTION
106	MX : MULTIPLEXER
107	RTS : RADIO TRANSMITTING SECTION
112	RRS : RADIO RECEIVING SECTION
113	CPICHDS : CPICH DESPREADING SECTION
114	DPCHDS : DPCH DESPREADING SECTION
115	DSCHDS : DSCH DESPREADING SECTION
116	CES : CHANNEL ESTIMATION SECTION
117	CES : CHANNEL ESTIMATION SECTION
118	DPCHDMS : DPCH DEMODULATION SECTION
119	PRES : POWER RATIO EXTRACTION SECTION
120	MMDS : MODULATION METHOD DETERMINATION SECTION
121	DSCHDMS : DSCH DEMODULATION SECTION

[FIG. 6]

	CC : CHANNEL CONDITION
101	CONT : CONTROLLER
102	DB : DATA BUFFER
103	DSCHMSS : DSCH MODULATION/SPREADING SECTION
104-1	DPCHMSS : DPCH MODULATION/SPREADING SECTION
104-K	DPCHMSS : DPCH MODULATION/SPREADING SECTION
106	MX : MULTIPLEXER
107	RTS : RADIO TRANSMITTING SECTION
112	RRS : RADIO RECEIVING SECTION
113	CPICHDS : CPICH DESPREADING SECTION
114	DPCHDS : DPCH DESPREADING SECTION
115	DSCHDS : DSCH DESPREADING SECTION
116	CES : CHANNEL ESTIMATION SECTION
117	CES : CHANNEL ESTIMATION SECTION
118	DPCHDMS : DPCH DEMODULATION SECTION
119	PRES : POWER RATIO EXTRACTION SECTION
120	MMDS : MODULATION METHOD DETERMINATION SECTION
602	DSCHDMS : DSCH DEMODULATION SECTION